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What is claimed is:

1. A steam generation apparatus dedicated to combustion of a fuel with an oxygen-enriched oxidant, wherein the oxygen concentration of the oxidant may range from just above 21 percent to 100 percent, the apparatus comprising:

a) an oxidant preheater for exchanging heat with a flue gas, the preheater having a geometry, a size and a heat transfer area to take advantage of i) a flue gas flow rate that is lower, and ii) a flue gas temperature that is higher, due to oxidant/fuel combustion, than a comparable power air/fuel combustion boiler base case;

b) means for introducing a fuel and the oxidant into a combustion space within a furnace of the boiler and combusting the fuel in the presence of the oxidant in order to generate the flue gas;

c) the furnace having a radiant heat transfer section with a plurality of radiant heat transfer section tubes, said tubes having reduced heat transfer area compared to the base case; and

d) a convection heat transfer section having a plurality of convection heat transfer section tubes positioned so as to afford increased heat transfer between the flue gas and boiler feed water traversing therethrough while using less heat transfer area over the base case of air/fuel combustion.

2. The apparatus of claim 1, wherein the radiant heat transfer section has a plurality of radiant section tubes, and the convection heat transfer section has a plurality of convection section tubes, the radiant heat transfer section tubes and the convection heat transfer section tubes constructed to withstand temperatures from combustion of said fuel and said preheated oxygen-enriched oxidant, each one of the plurality of radiant section tubes connected to one of the plurality of convection section tubes and being traversed therethrough by boiler feedwater

3. The apparatus of claim 1 including an economizer in the convection section for producing preheated feed water through heat exchange between feed water and said flue gases, the economizer constructed to withstand said flue gases.

4. The apparatus of claim 1 including at least one superheater for producing superheated steam, the superheater connected to at least a portion of the plurality of convection section tubes.

5. The apparatus of claim 1 including at least one steam drum, the steam drum connected to at least a portion of the plurality of convection and radiant section tubes.

6. The apparatus of claim 4 including an attemperator fluidly connected to at least one of the at least one superheaters.

7. The apparatus in accordance with claim 1 wherein the preheater is selected from the group consisting of tubular recuperative type heat exchangers, flat plate recuperative type heat exchangers, and regenerative heat exchangers.

8. The apparatus of claim 1 constructed to operate at supercritical pressure.

9. The apparatus of claim 8 constructed to operate at subcritical pressure.

10. The apparatus of claim 9 wherein water circulation in the apparatus is produced by means selected from the group consisting of gravity circulation, forced circulation, and combinations thereof.

11. The apparatus of claim 4 including a first expansion turbine, the first expansion turbine adapted to accept a first high pressure fluid from the superheater which is expanded to produce a low pressure fluid, and means to route the low pressure fluid to a reheater, the reheater allowing heat exchange between flue gas and said low pressure fluid.

12. The apparatus of claim 1 comprising means for local flue gas recirculation.

13. A method of operating the steam generation apparatus of claim 1 having reduced heat transfer area and increased efficiency for an equivalent air/fuel power production base case, comprising:

a) flowing the oxidant through the oxidant preheater and exchanging heat indirectly with the flue gas exiting the boiler, thus forming a preheated oxidant, the oxidant selected from the group consisting of oxygen-enriched air and oxygen;

b) introducing the fuel and the preheated oxidant into the furnace of the boiler and combusting the fuel with the preheated oxidant to generate the flue gas and thermal energy, the flue gas having a flow rate that is reduced compared to the base case; and

c) feeding the boiler with boiler feed water and circulating the water through the plurality of convection heat transfer section tubes and the purality of radiant heat transfer section tubes, in order to preheat and evaporate the water, and produce superheated steam by heat transfer between the flue gas and the boiler feed water.

14. The method of claim 13, wherein said oxygen-enriched oxidant has an oxygen concentration of at least 90%.

15. The method of claim 13, wherein said fuel is coal.

16. The method of claim 13, wherein a cost of emission control technologies to control release of species comprising those selected from the group consisting of CO2, NOx, SOx, particulate matter, and combinations thereof, is reduced due to the reduced flue gas flow rate and to a more concentrated form of said flue gas.

17. The method of claim 13 comprising flowing the flue gases through means for emission control after traversing the oxidant preheater.

18. The method of claim 13 comprising flowing a portion of the flue gases through means for flue gas recirculation prior to traversing the oxidant preheater.

19. The method of claim 13 comprising flowing a portion of the flue gases through means for flue gas recirculation after traversing the oxidant preheater.

20. The method of claim 15 comprising pulverizing said coal prior to said introducing step.